Informational interference from a competing talker: a thought-provoking but elusive construct

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Informational interference from a competing talker: a thought-provoking but elusive construct

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Background

Competing speech

- Energetic masking (EM) → Acoustic degradation at the periphery
- Informational masking (IM) → Acoustic-phonetic; Linguistic; Cognitive

Informational interference

Research questions

Overarching research question

1) Is a competing talker (EM+IM) more detrimental to sentence comprehension than energetic masking?

Yes: Koelewijn et al. (2012), Brungart et al. (2001), Brungart et al. (2013)
No: Dirks and Bower (1969), Hygge et al. (1992)

Specific research questions

Does the emergence of informational interference depend on the:

2) Linguistic complexity of the target speech?
   More syntactic complexity → higher demand on processing resources, e.g. Carroll & Ruigendijk (2013), Wendt et al. (2014)
3) Intrinsic processing capacity of the listeners?
   e.g. second-language listeners expend more processing resources to recognise and understand speech (Lecumberri et al., 2010)
4) Intelligibility of the target speech?
   e.g. high perceptual demands due to decreased signal-to-noise ratio
5) Content of the competing signal?
   If attention is automatically allocated to the competing signal, different contents should interfere differently with target processing.

Method

Participants

- Native listeners (L1 English), N = 36 (per experiment)
- Non-native listeners (L2 English, L1 Danish), N = 19

Materials

Target voice ♂ / Competing voice ♀

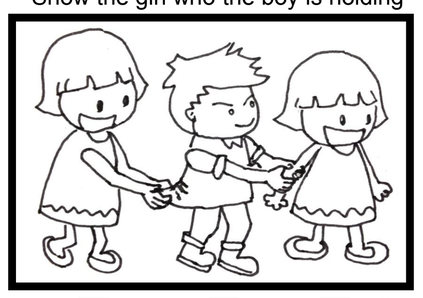
Increasing syntactic complexity of **target** sentence

Mask type	Simple sentence (120) *Show the girl with the black gloves*	Subject Relative (60) *Show the girl who is holding the boy*	Object Relative (60) *Show the girl who the boy is holding*
No mask			
HINT competing talker (EM+IM)	The tub tap is leaking. Some animals sleep on straw.	The black dog was hungry. The yellow pears taste good.	Strawberry jam is sweet. The kitchen clock was wrong.
Speech-modulated noise (EM)			
Reversed competing talker (EM)			
Neutral competing talker (EM+IM)	The parrot with the original puzzle is actually sweet.	The koala that is chewing the leaf is unbearably smelly.	The leaf that the koala is chewing is unbearably smelly.
Incongruent competing talker (EM+IM)	The boy with the black gloves is excessively clueless.	The boy who is holding the girl is unfortunately poor.	The boy who the girl is holding is interestingly great.
Congruent competing talker (EM+IM)	The girl with the black gloves is excessively clueless.	The girl who is holding the boy is unfortunately poor.	The girl who the boy is holding is interestingly great.

SNRs -5dB ≈ 95% transcription accuracy without pictures
-22dB (SMN) and -25dB (RCT & CT) ≈ 80% transcription accuracy with pictures

Task: speeded picture selection

"Show the girl who is holding the boy"
"Show the girl who the boy is holding"



DV1: Accuracy (button press)
DV2: Reaction times (button press)
DV3: Eye fixations to target character
DV4: Pupillometry

Cognitive measures

Auditory short-term /working memory:

- Non-word repetition (Alloway, 2007)
- Listening recall (Alloway, 2007)
- Digit span (forward and backward)

Visual selective attention:

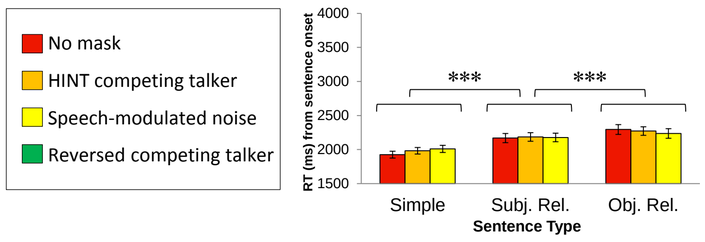
- Flanker task

Results

Reaction times from target sentence onset

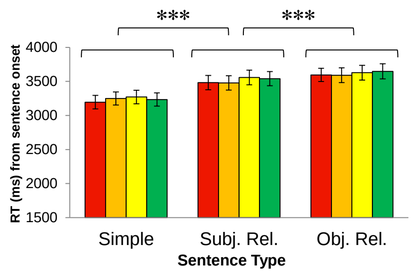
IM vs EM

SNR: -5dB
N = 36 natives



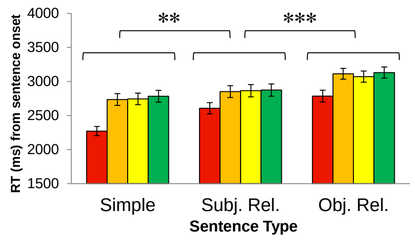
Main effect of sentence type (p < .001)
No evidence of informational interference

SNR: -5dB
N = 19 non-natives



Main effect of sentence type (p < .001)
Main effect of mask type (p = .008)
Trend: No mask < SMN (p = .06)
No evidence of informational interference

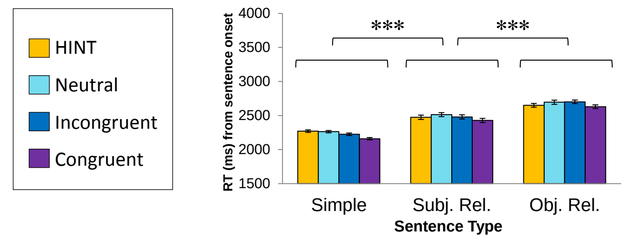
SNR: -22 (SMN) and -25dB (RCT & CT)
N = 36 natives



Main effect of sentence type (p < .001)
Main effect of mask type (p < .001)
Unmasked faster than masked (p < .001)
No evidence of informational interference

Competing talker semantic content change

SNR: -5dB
N = 36 natives



Main effect of sentence type (p < .001)
Main effect of mask type (p < .001)
Congruent faster than other masks (p < .01)
Semantic facilitation but no interference

Accuracy

- At -5dB SNR, L1 and L2 listeners highly accurate (>90%)
- Effect of syntactic complexity (except L1 listeners at -5dB SNR)

Eye fixations

- Fixations to correct character were made before the end of the target sentence
- No difference between masks at -5dB SNR
- Difference between unmasked and masked in eye fixations at low SNRs.

Pupillometry

- Peak pupil dilation as a measure of processing load
- No difference between masks at -5dB SNR
- Difference between unmasked and masked in peak pupil dilation at low SNRs.

Cognitive measures

No correlations were found between any of the cognitive measures and the reaction times or accuracy for the sentence comprehension task.

Conclusions

1) Is a competing talker more detrimental to sentence comprehension than energetic masking?

Not always! No effect of informational interference found in this study.

Specific questions: does the emergence of informational interference depend on the:

2) Linguistic complexity of the target speech?
Main effect of syntax, but not modulated by mask type.

3) Intrinsic processing capacity of the listeners?
L2 listeners use more processing resources, but not modulated by mask type

4) Intelligibility of the target speech?
Effect of mask vs no mask at low SNR, but not modulated by mask type.

5) Content of the competing signal?
Semantic priming indicates that the mask is not always ignored.
Suppression of irrelevant/incongruent mask: **strategic informational filter**?

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